A 16881
NCE3-1808
22 April 1953

COUNTRY: Sweden/Netherlands/France

SUBJECT: High Frequency Electronics Research in Western Europe

PLACE ACQUIRED -------

DATE ACQUIRED: Sep thru 4 Nov 52

DATE OF INFO: Sep thru 4 Nov 52

SOURCE: US citizen, Ph.D., professor of physics at a well-known US university. In addition to teaching, he is working under contract to the US military establishment in the field of solid state physics. In the fall of 1952 he visited various European research institutes where he compared high frequencies research and instrumentation with that being conducted in the US.

/The information in this report has been obtained by the Department of the Air Force (Air Technical Intelligence Center) and is disseminated by CIA in accordance with paragraphs 2(h) and 3(e) of National Security Council Intelligence Directive #7./

New High Frequency Electron Tubes at Royal Institute of Technology (Kungl Tekniska Hogskolan, Stockholm (KTH)) - 13 Sep 52

1. Several entirely new electron tubes have originated in the Division of Electronics at the KTH under Professor Hannes Alfven. Under his direction the trochotron, strophotron and space charge beam deflection tubes have been developed. I saw an early design of the strophotron used by Dag Romell in the Division of Electronics. This particular system will oscillate with anode voltages of about 1000 volts with efficiencies of 10 to 15%, and it can be frequency modulated or electrically tuned over a frequency range from approximately 1000 to 1600 megacycles/sec. The magnetic field is not critical; the values of magnetic field usable ranged from 500 to 3000 gauss. The power output was about 1.5 watts. The best results are obtained when the cathode projects somewhat into the inter-electrode cavity.

2. The work of Alfven has branched off in other directions and he considers the following fields of more interest to him from a purely theoretical point of view:

   a. Theoretical and Experimental Studies of Aurorae and Magnetic Storms.

   b. Radar Echoes From Meteor Trails.

   c. Directional Effects in Cosmic Ray Measurements and Models for Experiments on Cosmic Ray Origin and Behavior.

   d. Theoretical and Experimental Studies of Magneto-hydrodynamics and Waves in Ionized Media.

   The latter subject of magneto-hydrodynamics is taking a large part of the staff and finances of this division. Several papers have been prepared on the subject.

Philips, Eindhoven - 26 September 1952

3. Here a discussion with Dr. F. Coeterier concerning velocity modulation and drift tubes yielded the information that with rather conventional Heil tubes they have obtained efficiencies at 30% with 10-12 watts output at 3 cm.

4. It was claimed that in magnetrons they had nothing to show me because they were still copying American magnetrons and that they had not yet gotten ahead of others in any phase of the work except possibly the question of the "L" cathode. Other work in Klystrons is being done but again it was claimed that they had nothing new in the field.

Compagnie Generale de Telegraphie Sans Fils - 31 Oct 52

5. There are a large number of interesting things to see at Compagnie Generale de Telegraphie Sans Fil (C.S.F.). Of the groups I visited there are two main divisions of interest:

   a. The electron devices or tube group under Robert Warnecke

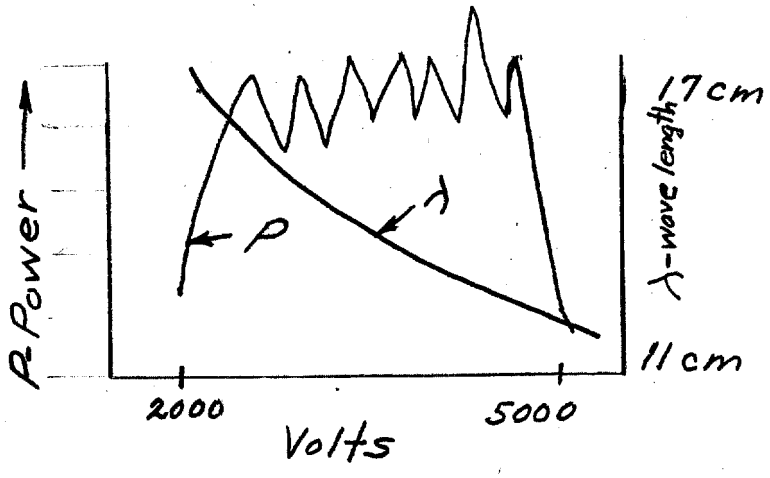
   b. The groups having to do with material and metallurgical problems in connection with special alloys and sintered materials, ceramics for condensers, thermistors and semiconductors.

6. I was taken to the laboratories by M. Villard who handles visitors and I visited first with Dr. R. Warnecke who told me about some of the more interesting recent tube developments (mainly performance results). These people are very patent conscious and quite touchy about just exactly who did what first. They are reluctant to discuss details of their work. Warnecke told me about the performance results on many tubes including the "carcinotron" and recent magnetron amplifiers, but he pointed out that all of the millimeter work was highly classified. They claim to have something really new and different in the way of generators of millimeter electromagnet waves -- first of all a generator of really short waves λ = 1--2 mm and less, secondly it is definitely not a tube generator using conventional circuits or cavities. The last remarks were interpreted by me as meaning some sort of interaction between a beam of charged particles and a solid material. (I do not believe that it is cherenkov radiation as someone has suggested) and I believe that there is a connection between the development of the "carcinotron" and the development of some solid state device for millimeter waves. I asked what sort of clearance was demanded to see this device and hear something about it. I explained that I had certain clearances in the United States, that my interest was entirely academic and that I had no commercial interests. I know of course that ONR has been working for some time on trying to get someone into CSF to learn what they really have. Warnecke said that the classification was largely a military matter and that if I could get someone to talk with Captain Moreau, the matter might be arranged. I went at once to Colonel Weldon of the Air

Force Office in Paris about this and after a couple of days waiting Captain Moreau refused the request for permission to see this work, giving reasons that obviously had nothing to do with the real reasons for refusing, It was pointed out that the work really was not ready to show (this was certainly contrary to the impression I got from Warnecke), but that when the work was ready to show they would have a demonstration and invite the Air Force personnel. It was pointed out by Moreau that an additional reason for refusing me was that I was not on the diplomatic list - a ridiculous bit of reasoning even for a Frenchman.

7. In connection with the carcinotron the operation of one of these devices is briefly described in Electronique under the title "Nouveaux tubes oscillateurs a' large bande d'accord electronique pour hyperfrequencies" by Guenard, Doehler, Epsztein and Warnecke - also in Radioelectricite "Sur les proprietes des lignes a structure periodique", by Guenard, Doehler and Warnecke.

8. The operation of the carcinotron was shown to me in diagram form. With a power output of 1 kilowatt C.W. and an efficiency of 50% the frequency spread of Δf between the 3 db points was 50%. The plot which I saw was as follows:



9. I brought up the question of magnetron amplifiers and asked whether these devices had been improved lately. I had seen the two magnetron amplifiers which arrived from CSF at Evans Signal Laboratory (Thermonius Branch), Belmar, N.J. in the summer of 1951. Warnecke said that the two tubes delivered to the Signal Corps in 1951 were made only to demonstrate that such tubes would operate satisfactorily and that more recent magnetron amplifiers were much better. One such tube for CW operation with λ = 20 cm has a power output of 400 watts with efficiencies varying from 35 to 50% Gain = 12-18 db and Δf_{3db} = 15 mcs. Using a pulsed model with λ = 10 cm and power output of 1 megawatt the efficiency is about 50%. The Gain = 15 db and Δf_{3db} = 25 - 30%.

10. Warnecke pointed out that the magnetron amplifier had very considerable advantages in a typical radar system where the sending and receiving branches can now be connected directly to the oscillator.

11. I had asked earlier to see the tube shop and laboratories, but this, while not refused, was not encouraged. In any case by the time I finished talking with Warnecke it was time to go visit another part of the company (they had everything rather well scheduled). Since I hoped to return to hear more about the millimeter work anyway, I didn't press the tube shop and laboratory matter. I didn't realize at the time just how much it would take to get me this information, although I was aware of the lack of success by ONR people.

La Compagnie Francaise Thomson-Houston
Le Centre de Recherches Physiques - 4 Nov 52

12. This group under the direction of M. Matricon is rather small and seems to be interested entirely in work on very short microwaves. The main work is connected with microwave spectroscopy and absorption in gases and much of this work is done by Matricon and Dr. E. Roubine. The wave length regions of interest here are the K band 18,000 to 26,500 megacycles and the J band 26,500 to 40,000 megacycles.

13. The group has built a very elaborate and beautifully built demountable reflex klystron operating in the voltage range from 1800 to 2800 volts with beam currents from 10 to 20 milliamperes.

14. There are two sets of parts for this demountable tube, one set corresponding to the K band range and one set corresponding to the J band range. This demountable arrangement seems to work well. I did not see any other physical research in this laboratory. The main effort seems to be in the work mentioned above.